Life history of *Philotes enoptes bayensis*
(Lepidoptera : Lycaenidae)

ROBERT L. LANGSTON AND JOHN ADAMS COMSTOCK
University of California, Berkeley and San Diego Society of Natural History

The type locality of *Philotes enoptes bayensis* Langston was designated as China Camp, Marin County, California (Langston, 1964). However, the largest colony of this blue yet discovered is across San Francisco Bay near Point Richmond, Contra Costa County. This colony was originally found in 1962, 4 years after the first China Camp specimen. The subspecies is known from 13 localities in six counties: Contra Costa, Humboldt, Marin, Mendocino, Solano, and Sonoma (Langston, 1965).

The term "colony" is especially appropriate as the adults do not appear to stray very far from their food plants. The Point Richmond locality actually consists of two colonies. One is on steep, south-facing slopes, and the other is approximately one-fourth mile away on west-facing slopes.

HOST PLANTS.—In Marin and Sonoma counties the blue is associated with *Eriognonum latifolium nudum* (Douglas *ex* Bentham) S. Stokes. In Solano and Contra Costa counties it is on *E. latifolium auriculatum* (Bentham) S. Stokes. Depending upon the season, the *E. l. auriculatum* may come into bloom by mid-May on the south-facing slopes at Point Richmond. Although the general area is often overcast or foggy, these slopes become quite hot on sunny days, and warm quickly with brief sunshine on the overcast days. The west-facing slopes are subject to colder influences. More fog often exists and even when the sun is shining, the slopes are subject to a cool northwest wind. As a consequence, the *Eriogonum* blooms 2 to 4 weeks later on the west-facing slopes, at least during the four seasons (1962–1965) observed. The plants are in their best bloom in mid-June, and in two of the four seasons were still in a *Philotes*-attracting stage the first week of July.

ADULT SEASON.—Adult emergence is synchronized closely with the blooming period of this *Eriogonum*. An appreciable number of adults are noticed when 30 to 40% of the flowers are in early bloom, the rest still being in the bud stage. The greatest numbers of adults occur when 40 to 60% are blossoming. By the time most plants have come into full bloom, the earlier blossoms have dried and the adults have practically disappeared.

The advantage of the Point Richmond locality is not only the presence of dense colonies, but a spread in season between the south- and west-facing slopes. Adults have been taken as early as 17 May on the

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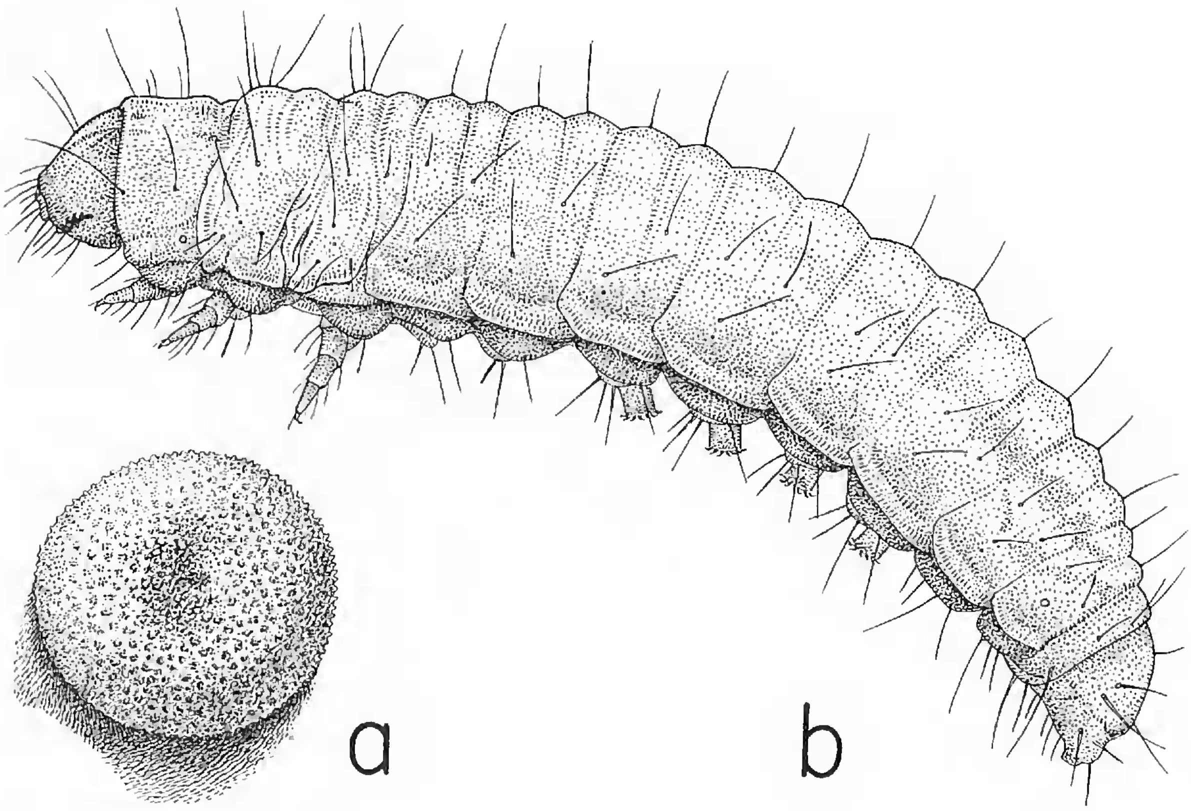

Fig. 1. *Philotes enoptes bayensis* Langston: a, Egg, 2 days old, viewed from above; b, First-instar larva, lateral.

south slopes, and as late as 4 July on the west slopes. During any single season *Philotes enoptes bayensis* adults were found at any one colony for only about 2 weeks in the year. This extended to 3 weeks if there was a long period of cold, overcast weather. Adult activity at the south slope colony was essentially finished when the west slope colony was just beginning.

The adults can be considered common over this short period of time. During the 1962 to 1965 seasons a total of 338 specimens were collected by the senior author at Point Richmond. Attempts were made to capture every individual observed when they were scarce at the beginning or end of the flight periods. During their peak flights, only random samples were made over timed periods. The most productive 1-hour period was on 15 June 1965 when 63 were taken (36 males, 27 females) on the west-facing slope.

OVIPOSITION.—The adults are closely associated with the *Eriogonum* flowers. They take nectar, copulate, and often rest at night on the floral heads. Females also oviposit in or on the flowers. The eggs are usually laid singly on sepals of the newly opened flower or on the late bud stage. Eggs are occasionally found on the white petals or a short distance down the pedicel.

EGG SEASON.—The eggs are laid shortly after copulation. Hence this subspecies is in the egg stage from late May to mid-June on the south slope, and from mid-June to early July on the west slope. The variation in time can be accounted for by the spread in adult flight as noted above, and the exposure of the individual plants.

LARVAL SEASON.—Caterpillars are present from early June to early September. Even though there may be a rather uniform, short period of oviposition, the larvae tend to become staggered, both in instars and time. Several variables are encountered during the midsummer larval season. On the hot, south slopes the eggs hatch quickly (7 to 12 days), and the larvae tend to develop rapidly. The *Eriogonum* plants dry rather soon, but some larvae have slower development because of wandering to other flower heads or to different plants. On the cooler west slopes the eggs take longer to hatch (10 to 15 days). The larvae tend to mature more slowly under the cooler temperatures, although the plants appear to stay in good condition much longer. Therefore, in early July, first-, second-, and third-instar larvae were collected on the south slopes. By mid-August, no larvae could be found on the south slopes, but third-, fourth-, and fifth-instar larvae were collected on the west slopes.

The larvae in all instars feed only on the flower heads. By late August when mature larvae are found, many of the flowers are well into the seed stage and the plants look dry. The flowers are unattractive as a nectar source, and in September even the Hymenoptera and Diptera ignore them.

PUPAL SEASON.—The time of pupation was not determined in the colonies. However, mature larvae were caged out-of-doors under conditions somewhat simulating a natural situation. They were even furnished with ants—a phenomena already known in other Lycaenidae (Downey, 1962). From south slope collections in 1965, pupation occurred from early to mid-August. From west slope collections in 1965, pupation took place from mid- to late August, with a few stragglers extending into the first week of September. Although pupae have not, as yet, been observed in the laboratory throughout the winter, the only assumption to make is that they diapause with the adults emerging the following May, June, or early July. Either or both Point Richmond sites and the Point San Pablo locality, 4.5 miles to the north–northwest, have been checked during the four seasons under study at least once every month of the year. The adults are not evident at any other times than indicated above.

OBTAINING EARLY STAGES.—Adults were placed in screen cages with

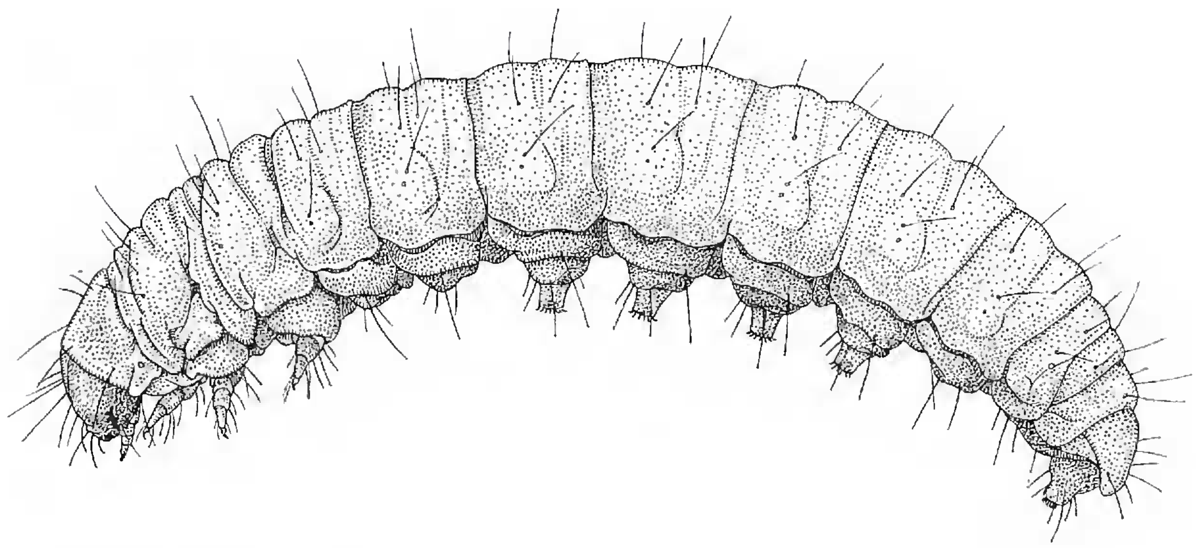

Fig. 2. *Philotes enoptes bayensis* Langston: Second-instar larva, lateral.

their food plant to obtain eggs. However, in confinement, relatively few eggs were laid in proportion to the large numbers of adults caged. Four groups of adults were caged at different times during the 1964 and 1965 seasons. Two of the four groups were divided and kept in the shade for varying intervals to obtain eggs later in the year. The numbers varied from 12 to 36 adults depending upon availability at time of collection. Sex ratio was essentially 1 : 1, but sometimes favored the female if they were slightly worn and assumed to be already fertile. Several were caged as copulating pairs. A total of 85 eggs were sent to the junior author in several batches at different times. This was repeated more often than planned as the larvae would not feed on substitute species of *Eriogonum*. Considerable difficulty was encountered in rearing *P. enoptes bayensis* in the laboratory, hence the following descriptions are based on fewer individuals than would be significant to state size variations within each of the stages.

Egg.—Diameter, 0.5 mm. Height, approximately 0.25 mm. Flattened echinoid form, deeply depressed in center of upper surface, with well-defined deeper micropyle. Pale green color, with white highlights. Surface covered with a regular network of hexagonal pits, separated by well-defined walls.

The newly hatched larva consumes the upper part of the egg, leaving the base and part of the sidewalls intact. In the laboratory, the egg period was from 10 to 14 days (Figs. 1a, 3a).

First-instar larva.—Length, 1 mm. Head width approximately 0.2 mm. Head glistening jet black. Body light yellow and comparatively wide in relation to head. Body segments developed as transverse ridges. Setae translucent and relatively long (Fig. 1b).

Second-instar larva.—Length, 4 mm. Body width, 0.5 mm. Head width approximately 0.4 mm. Head and ocelli still jet black as in prior instar. Prominent black cervical shield. Body ground color light yellow. Four dark yellow longitudinal stripes on dorsum running length of body, and two additional stripes of same character, but less clearly defined, running along stigmatal area. Legs yellow, tipped with brown. Prolegs yellow. Setae white, and relatively long. Toward the end of the instar, the thoracic segments and the last three caudal segments become tinged with pink (Fig. 2).

Third-instar larva.—Length, 4.5 mm. Body width 1.5 mm. Head width approximately 0.75 mm. (Measurements small, as the larvae were somewhat starved because the food plant was too dry and they would not feed on fresh substitute *Eriogonum.*) Head glistening yellow–brown, ocelli black. Body ground color light yellow. Same longitudinal darker yellow stripes present, but more clearly defined than in second instar. Pink suffusion gradually extends over all segments. Setae relatively short. In other particulars the body is similar in appearance to the prior instar (Fig. 3b).

Fourth-instar larva.—Length, 7.5 mm. Width at third thoracic segment, 3 mm. Head width approximately 1 mm. Head glistening yellow–brown, black mandibles, brownish maxillae, and black ocelli. Body becoming more slug-shaped than third instar. Ground color light yellow. Longitudinal yellow stripes somewhat obscured as pink suffusion more extensive over all segments. Over most of the body there is a covering of small setae, mostly yellow and some black.

Fifth-instar larva.—Length, 11.5 mm. Width at third thoracic segment, 5 mm. Head width approximately 1.1 mm. Head glistening yellow, except for the black mandibles, brownish maxillae, and black ocelli. Body slug-shaped as with most Lycaenidae, but with slight tendency to taper caudally. Body color nearly uniform rose–yellow throughout, with no spots or stripes. A few areas show slightly more intense rose shading, but they are depressions rather than spots. Legs and prolegs concolorous with body. Infrastigmatal fold well developed, but has no differentiating color. Spiracles concolorous with body, and indistinguishable without high magnification. Venter slightly lighter than dorsum. Most of body surface has a thick covering of small setae, many of which are yellow, some are black, and a few are mixed. This vestiture of yellowish spicules somewhat obscures the rose tint that constitutes the body surface (Fig. 3d).

With other members of this genus previously observed (Comstock and Coolidge, 1930; Comstock and Dammers, 1932) the mature larvae have much heavier spots, stripes, and geometric patterns than does *P. enoptes bayensis.*

Pupa.—Length, 6.5 mm. Width at fourth abdominal segment, 3.5 mm. Color, head, thorax, and wing cases translucent yellow. Abdominal segments brownish yellow, darkest near cauda. Spiracles black and relatively inconspicuous. Head rounded, eyes not bulging. Maxillae exposed for short distance, covered for more than half their length. Antennae prominent, relatively wide, and terminating at wing margins. Texture of surface appears smooth superficially, but under magnification shows rugosities, particularly over head and abdominal segments (Figs. 3c, 3e).

Summary

The adult flight of *Philotes enoptes bayensis* is from mid-May to early July. In Contra Costa County, California, oviposition is on the early flowers or late buds of *Eriogonum latifolium auriculatum.* Larvae feed only on the flower heads, maturing in August or early September,

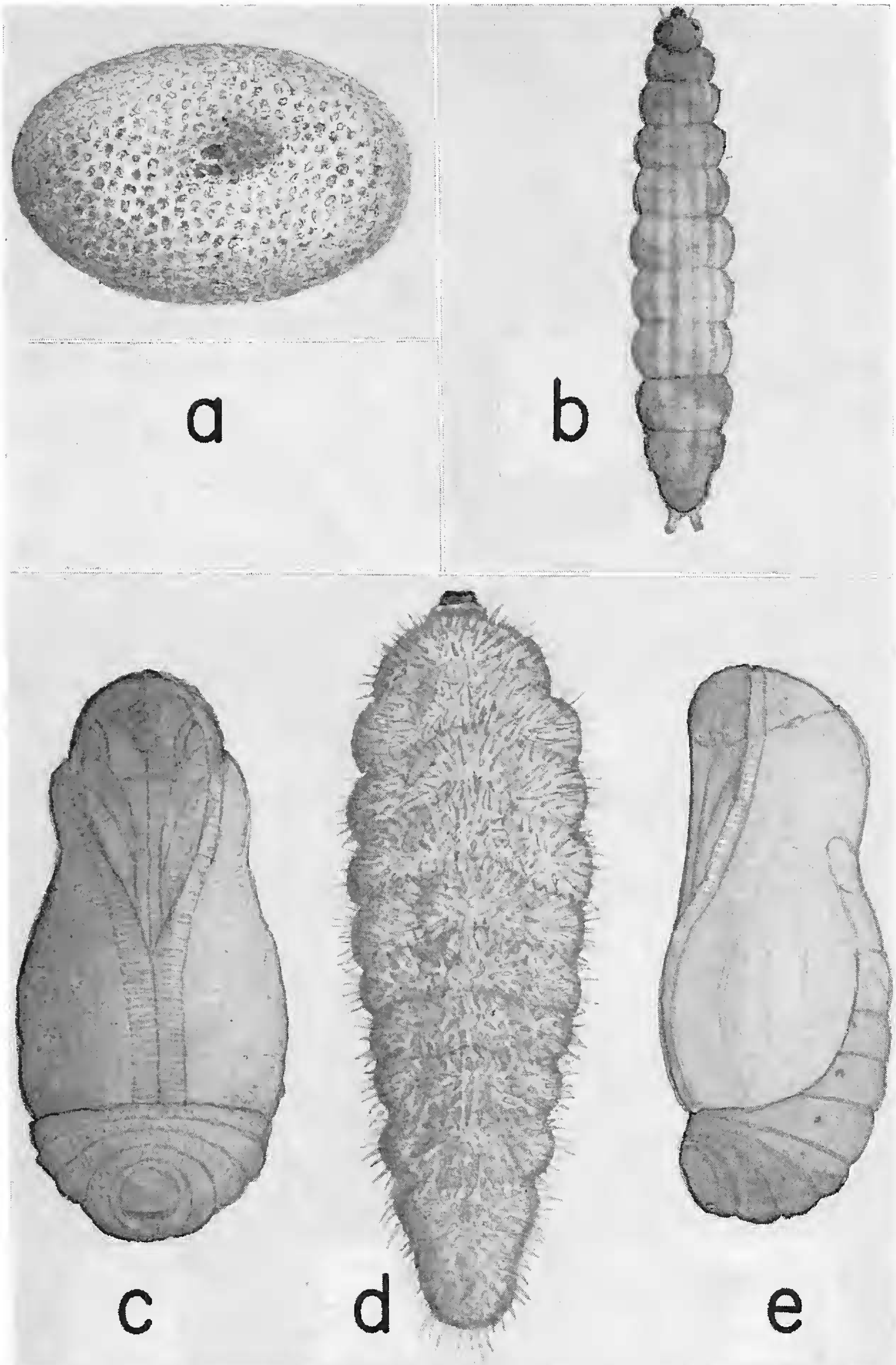

Fig. 3. *Philotes enoptes bayensis* Langston: a, Egg, 12 days old, viewed from side and slightly above; b, Third-instar larva, dorsal; c, Pupa, ventral; d, Fifth-instar larva, dorsal; e, Pupa, lateral. (Reproduced from watercolor by J. A. Comstock.)

depending upon locality and food-plant exposure. Pupation occurs immediately after larval development, the pupae entering diapause until the following May, June, or July. The egg, larval, and pupal stages are described and illustrated.

Literature Cited

Comstock, J. A., and C. Coolidge. 1930. The life history of *Philotes sonorensis* Felder. Bull. So. Calif. Acad. Sci., 29 (1): 17–21.

Comstock, J. A., and C. M. Dammers. 1932. The metamorphosis of six California Lepidoptera. Bull. So. Calif. Acad. Sci., 31 (3): 88–100.

Downey, J. C. 1962. Myrmecophily in *Plebejus (Icaricia) icarioides* (Lepid.: Lycaenidae). Entomol. News, 73 (3): 57–66.

Langston, R. L. 1964. *Philotes* of central coastal California (Lycaenidae). Jour. Lepid. Soc., 17 (4): 201–223.

1965. Distribution and hosts of five *Philotes* in California (Lycaenidae). Jour. Lepid. Soc., 19 (2): 95–102.

A new *Phytomyza* species from California
(Diptera : Agromyzidae)

Kenneth A. Spencer
19 Redington Road, London, N.W. 3, England

Frick (1959: 436) identified as *Phytomyza sphondylii* Robineau-Desvoidy (cf. Hendel, 1931–1936: 483) a species he had bred from leaf mines on *Heracleum lanatum* Michx. in California. I have recently examined a series of this species from Strawberry Canyon, Berkeley Hills, Alameda County, California, reared by M. J. Tauber and C. A. Toschi and although it very closely resembles *P. sphondylii* from Europe morphologically, comparison of the male genitalia with those of a reared male of *P. sphondylii* shows immediately that it represents a new species which can be briefly described as follows:

Phytomyza lanati Spencer, new species

Head. Frons broad, at least twice width of eye, not projecting above eye in profile; one strong upper orbital bristle, dorsal bristle substantially weaker, reduced to a minute setula or entirely lacking; two lower orbitals, the dorsal one strong, the ventral significantly weaker; jowls broad, one-third vertical height of eye, deepest at rear, frequently rounded in lower corner rather than angular; third antennal segment rounded, without conspicuous pubescence. *Mesonotum*: Four strong dorsocentrals, acrostichals irregularly in four rows in front, normally reduced to two rows at rear, ending between first and second dorsocentrals. *Wing*:

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